Section II. REMARKS

Rewriting of Prospectively Allowable Claim 27 in Independent Form

In the May 19, 2003 Office Action, claim 27 was objected to as being dependent on a rejected base claim, but indicated as "allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims" (page 8 of Office Action).

In response, claim 27 has been rewritten in independent form. It therefore is requested that claim 27 be formally allowed, consistent with the November 18, 2003 teleconference between the undersigned attorney and Examiner Le.

Rejection of Claims on Reference Grounds, and Traversal Thereof

In the May 19, 2003 Office Action, claims 1-26 and 28-39 were rejected on reference grounds, including:

a rejection of claims 1-8, 11-12, 14 and 16-17 under 35 U.S.C. §102(e) as anticipated by Tsu et al. USP 6,294,420 (hereafter "Tsu");

a rejection of claims 1-10 and 18 under 35 U.S.C. §103(a) as unpatentable over Lu et al. USP 6,365,517 (hereafter "Lu") in view of Tang et al. USP 6,462,931 (hereafter "Tang"); and

a rejection of claims 13, 15, 18-26 and 28-39 under 35 U.S.C. §103(a) as unpatentable over Tsu in view of Tang.

Such rejections of claims are traversed in respect of claims 1-26 and 28-39 as amended herein, and consideration of the patentable distinction of such amended claims is requested in light of the following remarks.

§102 Rejection of Claims 1-8, 11-12, 14 and 16-18 as anticipated by Tsu et al.

Claim 1 recites a microelectronic structure comprising, *inter alia*,

> **"at least one conductive barrier layer in contact with the layer of high dielectric constant material, wherein such conductive barrier layer comprises at least one material selected from the group consisting of Pt, Ir, IrO_2, Ir_2O_3, Ru, RuO_2, TaN, NbN, HfN, ZrN, WN, W_2N, TiAlN, TaSiN, NbAlN, and compatible combinations, mixtures and alloys thereof;**
>
> **at least one metal layer in contact with the conductive barrier layer, wherein said metal layer comprises metal or metal alloy including a material selected from the group consisting of Cu and Al"**

The Examiner has incorrectly rejected claim 1, and claims 2-8, 11-12, 14, 16 and 17 dependent thereunder, on §102(e) grounds based on Tsu. Specifically, the Examiner has mischaracterized Tsu at pages 2-3 of the May 19, 2003 Office Action, citing Tsu as disclosing, *inter alia*,

> **"at least one metal layer 20 in contact with the conductive barrier layer 22, wherein the metal layer 20 comprises metal or metal alloy including a material selected from the group consisting of Al, column 4 line 27, wherein at least one conductive barrier layer 22 is between at least one layer of high dielectric constant material 16 and at least one metal layer 20"**
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> (Office Action, paragraph bridging pages 2 and 3)

In fact, layer 20 of Tsu is a silicide layer.

See Tsu at column 4, line 26 ("a silicide layer"); column 4, line 66 ("the silicide **20**"); column 6, line 18 ("metal silicide **20**"); column 6, line 24 ("metal silicide layer **20**"); etc.

A silicide is a silicon compound.

Silicon is NOT a metal - silicon is a semiconductor.

Tsu clearly recognizes the distinction between metals *per se*, and silicides. The layer 20 is described by Tsu as being formed of various silicide materials, including "aluminum silicide ($AlSi_x$)" (column 4, line 27 of Tsu) and "metal alloy silicides" (column 4, line 29 of Tsu).

The nomenclature of the latter species ("metal alloy silicides") shows that "metal alloy silicides" is different from "metal alloys" as such - the metal alloy silicide contains silicon as an element whereas "metal alloys" do not. Metal alloys are homogeneous mixtures or solid solutions of two or more metals.

Thus, applicants' claimed invention, requiring "at least one metal layer," is different from and non-suggested by the silicides of Tsu.

Further, Tsu teaches that silicides are essential to the disclosed integrated circuit capacitor that is taught by Tsu. See, for example, Tsu at column 2, lines 40-49:

> **"The resultant structure provides a novel integrated circuit capacitor. In one embodiment, this capacitor includes a semiconductor region, a silicide layer disposed on the semiconductor region, a conductive nitride layer disposed on the silicide layer, a dielectric layer disposed on the silicide layer, and a conductive layer disposed on the dielectric layer. A second embodiment capacitor has a first electrode which includes a semiconductor region and a conductive nitride layer disposed on the semiconductor region. The conductive nitride includes a metal silicide."**
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> (Tsu, column 2, lines 40-49)

The next paragraph in Tsu (at column 2, lines 50-59) then emphasizes that such structure "has good oxidation resistance and high work function" and "better oxidation resistance and higher work function than pure metal electrodes."

Tsu therefore fails to teach or suggest the "at least one metal layer" that is required by applicants' claim 1, and (by virtue of their dependence from claim 1) claims 2-8, 11-12, 14 and 16-17, and there is no motivation in Tsu to vary the silicide layer in view of the performance benefits that are contended to result from the silicide layer-containing structure of Tsu.

The Examiner in the September 11, 2003 Advisory Action stated, inter alia, that:

> **"The Applicant argues that Tsu's 'metal silicide layer 20' is different from the 'metal alloy' of the claimed invention. This is not persuasive because it has been held that the use of the term 'comprise' leaves a claim open for inclusion of materials or step other than those recited in the claim (citing Ex parte Davis, 80 USPQ 448 (PTO Bd. App.))."**

In response, the claim language at issue is set out below:

> **"at least one metal layer in contact with the conductive barrier layer, wherein said metal layer comprises metal or metal alloy including material selected from the group consisting of Cu and Al"** (claim 1)

The Examiner has taken the position that applicants' recitation of "metal alloy" as a composition of applicants' recited "metal layer," includes Tsu's "metal silicide."

The Examiner's interpretation is at odds with the clear contextual meaning of the term "metal layer," as referring to a pure metal or mixed metal composition.

The application clearly describes metal electrodes in integrated circuit memory cells or other electronic devices - indeed, the title of the application, "Barrier Structures for Integration of High K Oxides With Cu and Al Electrodes," makes clear that the metalization referred to in the claims as constituting "at least one metal layer" is the electrode component of the recited microelectronic structure.

In this respect, see also the specification at page 4, line 12 (**"aluminum and copper have come into usage as alternative electrode materials"**) and at page 5, lines 14-16 (**"the present invention therefore relates to use of various barrier layers between the complex metal oxides of high dielectric constant and the Cu or Al electrodes, to avoid the above-discussed problems"**).

The Examiner's interpretation of "metal alloy" as being open to the inclusion of all materials other than those recited in the claim - e.g., wood, air, water, gas, etc - is a logical absurdity that is inconsistent with (i) the plain and simple recital of "at least one metal layer" and (ii) the clear and

unambiguous meaning of such term as understood by those skilled in the art from a reading of applicants' disclosure and claims.

A metal layer, simply stated, is a metal layer - it is not a metal silicide.

It is elemental patent law that the claims are construed and interpreted in light of the specification. See ***Markman v. Westview Instruments, Inc.***, 52 F.3d 967, 979 (Fed.Cir.1995) (en banc), aff'd, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996) ("Claims must be read in light of the patent specification. ")

Further, it is old and well-established law that a claim to a composition comprising ingredients cited in the claim does not necessarily leave the claim open for inclusion of predominant amounts of unspecified ingredients or in such proportions to have an adverse effect on the basic composition. See ***Ex parte Fitzpatrick*** (Pat.Off.Bd.App. 1947), 82 USPQ 59 and ***Ex parte Geemzki*** (Pat.Off.Bd.App. 1948), 82 USPQ 120. In this respect, it is to be noted that the replacement of a substantial amount of metal with silicon in the electrode as proposed by the Examiner (for this is the net result of using Tsu's silicide composition as "the metal layer") would have a severe adverse effect on the resulting layer, precluding its proper performance as an electrode.

For all these reasons, the Examiner is requested to reconsider claims 1, 2-8, 11-12, 14 and 16-17 as patentably distinct over Tsu, and to withdraw the §102 (e) rejection of such claims based on Tsu.

§103 Rejection of Claims 1-10 and 18 Over Lu in View of Tang

Concerning the Examiner's rejection of claims 1-10 and 18 based on Lu in view of Tang, Lu has been cited for disclosing a microelectronic structure featuring a TiN barrier layer between a metal layer (of aluminum or copper) and a high dielectric constant material, with Tang being cited as a secondary reference as allegedly disclosing that TiAlN can be used to replace TiN, the Examiner referring to column 9, lines 26-29 of Tang and stating that

> **"it would have been obvious to one of ordinary skill in the art to replace barrier layer 2/22 of Lu with Tang c nductive**

> **barrier, because such material substitution would have been considered a mere substitution of art-recognized equivalent values" (May 19, 2003 Office Action, page 4).**

The Examiner's proposed basis for substituting TiAlN from Tang for TiN in Lu is illogical, as is apparent from the entire text of column 9, lines 26-29 of Tang, which the Examiner has cited in support of the rejection:

> **"In all of the preferred embodiments the silicon diffusion barrier alternatively could be made of TiAlN, W_2N, TaN, and so forth intead [sic - "instead" apparently intended] of the example TiN"**
> (emphasis added; Tang, column 9, lines 26-29)

This teaching has reference to the preceding disclosure in Tang, at column 8, lines 11-13:

> **"A conductive silicon diffusion barrier may be used on top of polysilicon-filled vias as TiN in FIG. 1a to avoid Ir-polysilicon interactions"** (Tang, column 8, lines 11-13)

Thus, the teachings in Tang that the Examiner has cited as a basis for rejecting claims 1-10 and 18 are directed to *barriers between polysilicon and iridium*, and there is therefore no basis for modifying Lu in a way that would yield TiAlN between a high dielectric constant material layer and a copper or aluminum layer, as in applicants' claimed invention.

Further, Lu's teachings are specific to use of TiN, $TiSi_xN_y$ or TiN_xB_y (see column 4, lines 32-36 of Lu) to form thin film diffusion barriers that are characterized by Lu as providing "lower resistivity" (column 4, line 46) and "low contact/via resistance" (column 4, lines 48-49), as well as "higher purity, density, and stability of the films formed by the instant invention" (column 2, lines 17-18) - all suggestive of superior electrical performance. There is therefore no reason why one would change the specific barrier layer compositions taught by Lu, and risk the loss of such performance advantages. Additionally, the barrier cited in Tang is disposed between polysilicon and iridium, neither of which is a high dielectric constant material. Accordingly, there is no combination of Lu and Tang that yields the structure of applicants' claimed invention.

In sum, there is no basis in Lu or Tang for changing Lu's thin film structure in the manner proposed by the Examiner, and no basis in the aggregate disclosures of such references for deriving the applicants' claimed invention.

In the September 11, 2003 Advisory Action, the Examiner has taken the position that the Tang reference justifies using TiAlN in place of Lu's TiN, as equivalents, and the Examiner has stated that "substitution of equivalent requires no express motivation as long as the prior art recognizes the equivalency."

The prior art, however, has NOT held that TiN = TiAlN as a general purpose diffusion barrier.

To the contrary, Tang has proposed TiAlN as a **SPECIFIC BARRIER MATERIAL** for a **SPECIFIC BARRIER APPLICATION** requiring that the TiAlN constitute a barrier **BETWEEN SPECIFIC ADJOINING MATERIALS**, namely, polysilicon and iridium.

This is apparent from Tang's express teachings, at column 8, lines 11-13:

> **"A conductive silicon diffusion barrier may be used on top of polysilicon-filled vias as TiN in FIG. 1a to avoid Ir-polysilicon interactions"**
>
> (emphasis added; Tang, col. 8, lines 11-13)

Lu has no such polysilicon/iridium structure or diffusional problems.

Since Tang has a **different material composition**, and a **different microelectronic device architecture**, and since Lu very clearly teaches **ONLY the use of TiN, $TiSi_xN_y$ or TiN_xB_y** (see column 4, lines 32-36 of Lu) to form thin film diffusion barriers with **"lower resistivity"** (column 4, line 46 of Lu), **"low contact/via resistance"** (column 4, lines 48-49 of Lu), and **"higher purity, density, and stability ... films"** (column 2, lines 17-18 of Lu), the question that arises is,

> **"Why would one take Lu's very specific barrier compositions that are expressly stated to provide superior properties and performance advantages, and simply discard them, in favor of a substitution (from Tang) f a differ nt material, taken from a different structure that involves different diffusional issues?"**

The Examiner has not answered this question, but instead has taken a position that one barrier material is interchangeable with any other barrier material, for any purpose, regardless of the types of materials and diffusional species involved.

This is inconsistent with the applicable law.

In any obviousness determination based on combination of two or more references, there must be some suggestion or motivation to combine the references, in the teachings of the references, or from the ordinary knowledge of persons skilled in the art, or from the nature of the problem to be solved. The operative question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. See ***WMS Gaming, Inc. v. International Game Technology***, 184 F.3d 1339, 1355 (Fed.Cir. 1999) and ***B.F. Goodrich Co. v. Aircraft Braking Systems Corp.***, 72 F.3d 1577, 1582 (Fed.Cir. 1996) ("When obviousness is based on a particular prior art reference, there must be a showing of a suggestion or motivation to modify the teachings of that reference.")

To establish a prima facie case of obviousness based on a combination of the content of various references, there must be some teaching, suggestion or motivation in the prior art to make the specific combination that is present in the applicant's claimed invention. See ***In re Dance***, 160 F.3d 1339, 1342 (Fed. Cir. 1998) and ***In re Oetiker***, 977 F.2d 1443, 1445 (Fed.Cir.1992).

Tang's teachings are directed to barriers between polysilicon and iridium. There is no such structure in Lu, and no basis in Lu and/or Tang for importing the polysilicon and iridium barrier layer of Tang into the non-analogous structure of Lu.

The teachings of Tang and Lu **in the context of their overall disclosures of different materials and different device architectures** are relevant to the issue of their combinability, and must be considered. See ***W.L. Gore & Associates, Inc. v. Garlock, Inc.***, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) (a prior art reference must be considered in its entirety, as a whole, including portions that would lead away from the claimed invention).

One cannot select isolated features out of context, and re-implement them in a manner inconsistent with the contextual disclosure of their source references, simply by declaring such isolated features interchangeable for all purposes[1]. Rather than providing a proper basis for obviousness, such an approach shows only a hindsight attempt to reconstruct the applicants' invention. The law is clear in this respect. Obviousness cannot be established by hindsight combination to produce the claimed invention. ***In re Gorman***, 933 F.2d 982, 986, 18 USPQ2d 1885, 1888 (Fed.Cir.1991).

Tang and Lu provide no basis for utilizing TiAlN as a barrier material between a high dielectric constant material layer and a copper or aluminum layer, as in Applicant's claimed invention.

For all the foregoing reasons, the Examiner is requested to reconsider the microelectronic structure of claims 1-10 and 18 as patentably distinguished over Lu in view of Tang, and thereupon to withdraw the rejection of claims 1-10 and 18 based on such cited references.

§103 Rejection of Claims 13, 15, 18-26 and 28-39 Over Tsu in View of Tang

The rejections of dependent claims 13, 15, 18-26 and 28-39 based on Tsu in view of Tang suffer from the same deficiencies as noted in the discussion hereinabove of Tsu as a §102(e) reference in relation to applicants' claim 1, from which each of claims 13, 15, 18-26 and 28-39 directly or indirectly depends.

Accordingly, all of the Examiner's proposed respective modifications of Tsu, e.g., to incorporate various barrier layer materials of Tang, to use multiple barrier layers as in Tang, etc., do not change the fact that the resulting structures in every case would still have the silicide layer of Tsu, and would lack the "at least one metal layer" required by applicants' broad claim 1, from which each of claims 13, 15, 18-26 and 28-39 directly or indirectly depends.

Claims 13, 15, 18-26 and 28-39 therefore are patentable over Tsu in view of Tang, and the withdrawal of the §103 (a) rejection of such claims based on Tsu in view of Tang is correspondingly requested.

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[1] Just because an apple is a recognized equivalent to an orange *as a fruit* does not mean that oranges can be used to make applesauce.

Fee Payable for Rewriting of Claim 27 in Independent Form

Since the rewriting of claim 27 in independent form herein does not increase the total number of claims, nor the number of independent claims, beyond the numbers for which payment has previously been made in the application, no added claims fee is due or payable.

If it nonetheless is determined that any fee or amount is properly payable in connection with the entry of this response, the same hereby is authorized to be charged to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

Concurrent Submission of Notice of Appeal

This response is accompanied by a Notice of Appeal.

Extension of Time to November 19, 2003 by Request Under 37 CFR §1.136

Request hereby is made under the provisions of 37 CFR §1.136 for a three months extension of time, extending the term for response to the May 19, 2003 Office Action from August 19, 2003 to November 19, 2003. The fee specified in 37 CFR §1.17 of $950 for such three months extension of time hereby is authorized to be charged to Deposit Account No. 08-3284 of Intellectual Property/Technology Law, together with any other fee or amount necessary for entry of this Amendment.

Conclusion

Claims 1-39 as amended herein and now pending in the application, are patentably distinguished over the cited references, and in form and condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,

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